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RESEARCH ARTICLE

# Response of the Nigerian construction sector to economic shocks

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## Abstract

The construction sector (CS) is an economic barometer that mirrors the state of the economy. Therefore, the construction sector is susceptible to economic impacts. This study investigated the impact of economic shocks (measured with the Gross Domestic Product (GDP)) on construction sector performance. The study used econometric methodology which involves several sequential procedure including unit root test, cointegration test, causality and exogeneity tests. The data used was the Annualized time series data about GDP and construction sector. The data were extracted from the United Nations Statistics Division database based on the year 2010 US Dollars price over a forty seven (47) year period (1970-2016). The study found that the GDP significantly caused the construction sector output in all tests investigated. The study concluded that the construction sector significantly responded to economic shocks in both the short and long run. The study recommended that government should develop a policy framework that supports a concurrent development of the economy and the construction sector in Nigeria.

## Keywords

**Construction Sector (CS), Gross Domestic Product (GDP), Econometric Methodology, Government**



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## Introduction

The economy sets the landscape whereby human agents exploit, process and trade in scarce resources to enable the production, allocation, exchange and consumption of goods and services (Rees, 2015). The economy is therefore very important to stimulate economic activities, and consequently reduce poverty, raise income levels, create jobs, and drive human development (Department for International Development, 2008). The construction sector contribution to the economy is dependent on a number of factors. Firstly, the construction sector contributes more when the economy is growing because it provides a high investment multiplier to other sectors (Bykau and Khavalko, 2017; Qifa, 2013). However, the contribution of the construction sector to the economy through the multiplier effect is in the short run (Dlamini, 2012). The construction sector contribution to the Gross Domestic Product (GDP) is higher in developing countries because the diminishing returns of capital for investment are not as strong as the developed countries (Qifa, 2013). Specifically, the construction sector contributes to development when the construction value added is about 4-5 percent of the GDP (Lopes, Ruddock and Ribeiro, 2002). Secondly, the construction sector contribution to the economy is affected by macroeconomic variables such as inflation and interest rate (Erol and Unal, 2015). Thirdly, particularly in the small open economies, the construction sector creates the need for importation and balance of payment challenges. Hence, it limits the capacity to stimulate economic growth (Bykau and Khavalko, 2017). The importance of the construction sector particularly to developing economies is due to its contributions to the GDP, domestic fixed capital formation, employment generation and the government as the largest client (Hosein and Lewis, 2004; Hillebrandt, 1988, 2000; Wahab, 2005).

The construction sector accounts for up to 10 percent of the GDP, more than 50 percent of the domestic fixed capital formation, and one of the largest industrial employer (Du Plessis, 2001). The construction sector is often seen as a driver of economic growth especially in developing economies. Hence the sector has been used extensively by policy makers as a tool for economic development. For instance, public expenditure on construction is a used as a fiscal measure in many countries. Indeed, the importance of the construction sector to economic growth, especially in developing economies, is shown by the high construction sector output to the GDP ratio (Oladirin, et al., 2012; Ruddock and Lopes, 2006). The construction sector can mobilize and effectively utilize local, human and material resources in the development and maintenance of housing and physical infrastructure to promote employment and improve economic efficiency (Anaman and Osei-Amponsah, 2007). The construction sector lays the foundation for economic growth by providing critical infrastructure investment or domestic fixed capital needed for growth and development of the various sectors of the economy (Giang and Pheng, 2011). The contribution of the construction sector to other sectors such as material production and distribution sector, the transport, finance and the property market sectors has tremendous influence on the society and the environment, as well as the character of our world (Oladinrin, Ogunsemi and Aje, 2012). About one tenth of global economy is dedicated to constructing, operating and equipping buildings, and this activity accounts for 40 percent of the material flow in the world economy, with much of the rest allocated to roads, bridges and vehicles to connect the buildings (Roodman and Lennsen, 1994).

Field and Ofori (1988) stated that the construction sector is regarded as an essential and highly visible contributor to the process of growth. Park (1989) asserted that the construction sector generates one of the highest multiplier effects through its extensive backward and forward linkages with other sectors of the economy. Ofori (1990) attributed the importance of the construction sector to the high linkages with the rest of the economy. Akintoye and Skitmore (1994) suggest that construction investment is a derived demand which is growth dependent. Khan (2008) noted the construction sector is considered to be one of the major sources of economic growth and development. The construction sector is an integral part of the economy and industrial development, a prime source of employment generation offering job opportunities to millions of unskilled/skilled work force especially in developing economies. Lopes, Oliveira, Abreu (2011) showed that the evolution pattern of the share of construction value added in GDP in Sub-Saharan Africa is markedly different according to the country's stage of economic development as determined by gross national income per capita. Dlamini (2012) claimed that the construction sector has a potential of positive impact on economic growth. Kargi (2012) studied the Turkish construction industry and found that the growth rate of the construction industry in the developing countries is more than the GDP growth rate, and that the percentage it takes in the GDP of developed countries relatively diminishes.

The Nigerian economy is the biggest in Africa with a GDP valued at US1.221 trillion. Still, the country is a low income country. However, the country's economy is in transition from the low income to the middle income class. Therefore, the country is at a threshold of massive growth and development. Physical development through the provision of infrastructure in the construction sector is critical to the growth and development in Nigeria. It is on this premise that Nigeria is the focus in this study. Specifically, the Nigerian economic and construction sector performances provide a valid context of investigation in both practical and theoretical senses. Practically, the Nigerian economy has experienced significant but volatile GDP growth since 1960 through macroeconomic activities such agriculture and revenue from the sale of crude oil (Awojobi et al., 2014; Ekor et al., 2014; George et al., 2018). Contrastingly, Nigeria's investment in infrastructure is low over the same period. For instance, between 2007 and 2017, the annual average public spending on infrastructure is equivalent to about 3.6 percent of GDP, below the annual average of 4.3 percent in Africa over the same period (Bello-Schünemann and Porter, 2017). As a result, the Nigerian construction sector has experienced slow and declining contribution to infrastructure and the GDP (Oladirin, et al., 2012; Oluwakiyesi, 2011; Polycarp and Ubangiri, 2017). Theoretically, studies on the relationship between the Nigerian construction sector and economic growth are conflicting. Whereas a number of studies find positive relationships (see for example Okoye et al., 2016); some other studies revealed negative relationships (see for example Okoye, 2016). Therefore, any relationship between economic performance and the construction sector in Nigeria remains conflicting. More study is needed to clarify the conflict. It is against the backdrop of the foregoing that this study investigated the response of the Nigerian construction sector to economic shocks. The Nigeria's government Economic Recovery and Growth Plan (ERGP) (2017-2020) lays out government's plan to restore growth after the economic recession in 2016. This study is of significance to reveal economic action plans in the construction sector that can contribute to the ERGP.

## Literature Review

### THE IMPACT OF GDP ON THE CONSTRUCTION SECTOR (CS) INVESTMENT DEMAND

The demand for the construction sector investment is derived from the demand for consumer goods. The principal distinguishing feature of the construction sector is the extremely unstable demand for its products. Construction investments can be postponed, and the perceived need is directly dependent on the state of the economy and government fiscal and monetary policies. A period of real GDP growth tends to raise consumer demand for goods and services which in turn triggers the demand for construction investment (Tse and Ganesan, 1997). Thus, the construction sector investment demand is highly susceptible to business cyclical fluctuations; state of the economy including shocks and government (fiscal & monetary) policies. The combined detrimental effect of these factors on construction sector investment is the unstable /volatile nature of construction sector demand (Hillebrandt 1988, 2000). Following the paradigm shift toward a market economy dominated by the private sector, the trend of construction sector demand indicates a disproportionate increasing level of private to public investment (Akintoye and Skitmore, 1994).

The investment function is any variable that can motivate investors to change their typical buying and selling behaviours to either take advantage of the economic shift in a bid to increase their returns, or to minimize their loss incurred as a result of that shift. Rational investor will normally consider the current level of economic activities (i.e. GDP) and the real interest rates. The construction investment function at firm level is given by equation (1):

$$\mathrm{CNS} \Rightarrow \mathrm{f}(\uparrow \mathrm{GDP} + \downarrow \mathrm{INT.RATE} + \uparrow \mathrm{Tobin's\ q}) \tag{1}$$

The construction investment function indicates that real interest rate is negatively related to construction investment given that the interest rate is a measure of the opportunity cost of capital while the GDP and Tobin's q are positively related to investment (Burda, 2005). The Tobin's q is the ratio between a physical asset's market value and its replacement value (Market value of capital /Replacement value of capital). The Tobin's q is a nexus between financial markets and markets for goods and services. If Tobin's q is 1.0, then the market value reflects just the recorded assets of a firm. If Tobin's q is greater than 1.0, then the market value is greater than the value of the recorded assets of the firm. High Tobin's q favour new capital investment because they are worth more than the price paid for them. If a firm's stock price (firm's capital market value) is £1 and the price of the capital in the current market is £0.5; the company may issue shares and subsequently invest in capital goods with the proceeds. However, if Tobin's q is less than 1; the market value is less than the recorded value of the assets of the firm. This suggests that the firm may have been undervalued by the market (Brainard and Tobin, 1968; Tobin, 1969).

## THE NIGERIAN CONSTRUCTION SECTOR

A growing number of studies did focus on the Nigerian construction sector. Olatunji and Bashorun (2006) report that the Nigerian construction sector contributes an average of 5-7 percent to the GDP. The sector also contributes over 40 percent of the domestic fixed capital formation. Anyanwu, Ibekwe, Adesope, (2010) revealed that the Nigerian construction sector is significantly related with all the sectors of Nigeria economy. The results of the independent t- tests in the study showed that all p- values were greater than 0.05. Therefore, the study indicated that the Nigerian construction sector plays significant roles in all the sectors of the Nigerian economy. Saka and Lowe (2010) found that construction significantly leads many sectors and virtually all economic sectors feedback into the construction sector, hence the mutual inter dependence between the construction sector and other sectors in the economy. The study concluded that the Nigerian construction sector is very important because of its significant forward and backward linkages and multipliers on sectors of the

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economy. Oladinrin, Ogunsemi and Aje, (2012) found a strong relationship between the Nigerian construction sector and the economy. It is possible that expansion of the Nigerian construction sector activities is preceded by an increase in economic output, with the initial effect felt largely within the Nigerian construction sector and only subsequently on the aggregate economy. Isa et al., (2013) found that the Nigerian construction sector contributed between 3 and 6 percent to the GDP from 1960 to the 1980 before crumbling to around 1 percent. Anyanwu et al. (2013) used multiple regression to examine the impact of economic sectors on the GDP covering the period 1960 to 2008. The results showed that agriculture share of the GDP was the highest while construction made the least contribution to the GDP. The National industrial revolution plan report (2014) revealed that although the Nigerian construction sector is a fast growing sector of the economy, which recorded a growth rate of more than 20 percent between 2006 and 2007, the overall contribution of the Nigerian construction sector to the GDP remained very low at 1.83 percent in 2008. Okoye et al. (2016) using Nigerian data between 2010 through 2015 revealed a negative and insignificant relationship between the Nigerian construction sector and the GDP. Okoye (2016) using Nigerian data revealed a very strong relationship between the Nigerian construction sector and the GDP, with about 50 percent of the proportion of variations in the real GDP attributed to the Nigerian construction sector.

## Econometric Methodology

The basic work horse of multivariate time series analysis is the Vector AutoRegression (VAR) model. This is a direct generalization of the univariate autoregression (AR) model to dynamic multivariate time series data. The VAR model has proven to be especially useful for describing and forecasting the dynamic behaviour of economic and financial time series data. It is also used for structural inference and policy analysis (Patterson, 2000). Following the Granger representation theorem, VAR can easily be transformed into the Vector Error Correction Model (VECM). When the I(1) variables are cointegrated, the approach of formulating the VAR model in first difference is inappropriate. The correct model is a cointegrated VAR in levels or a VECM i.e. a VAR in first differences together with the vector of cointegrating residuals (Robertson and Wickens, 1994). According to Engle and Granger (1987) when a set of variables I(1) are cointegrated, then short run analysis of the system should incorporate an error correction term in order to model the adjustment for the deviation from its long run equilibrium. The VECM is therefore characterized by both differenced and long run equilibrium models thereby allowing for estimates of short run dynamics as well as long equilibrium adjustment process. The VECM is specified as follows:

$$\Delta LCNS_t = \phi_1 + \sum_{i=1}^{p-1} \beta_{11} \Delta LCNS_{t-1} + \sum_{i=1}^{p-1} \beta_{12} \Delta LGDP_{t-1} + \alpha_{11} ECT_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta LGDP_t = \phi_2 + \sum_{i=1}^{p-1} \beta_{21} \Delta LCNS_{t-1} + \sum_{i=1}^{p-1} \beta_{22} \Delta LGDP_{t-1} + \alpha_{21} ECT_{t-1} + \varepsilon_{2t} \quad (2)$$

Where i=1….N denotes the lag, t=1….T denotes the time period; $\varepsilon_t$ is assumed to be serially uncorrelated error term; ECT is the lagged error term derived from the long term cointegrating relationship. According to Ang and McKibbin (2007), three types of Granger causality tests can be performed through the VECM framework: the short run Granger causality, the long run weak exogeneity and long run strong exogeneity tests.

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### TIME SERIES DATA

The annualized time series data for the study was extracted from the United Nations Statistics Division available at http://unstats.un.org/unsd/economic. The data were based on GDP/breakdown at constant 2010 US Dollars. The data covers a forty seven (47) year period from 1970 to 2016. This includes the GDP and the construction sector performance data.

## Definition of Terms

### GROSS DOMESTIC PRODUCT (GDP)

This entry in the national account statistics is the aggregate monetary value of all final goods and services produced in a country within a given year (in 2010 USD price) (Begg, Fischer and Dornbusch, 2000).

### CONSTRUCTION SECTOR (CS) OUTPUT

This entry in the national account statistics is the total expenditure on new constructed facilities and on the maintenance of constructed facilities within the economy in a given year. This entry in the national account also includes money expended (Adamu, 1996).

### CAUSALITY AND EXOGENEITY TESTS

Causality concerns actual links between variables in the economy, whereas exogeneity is the property of being 'determined outside the model under analyses, thus it concerns the analysis of models conditional on putative exogenous variables without loss of relevant information. Concepts of weak, strong and super exogeneity relate contemporaneous explanatory variables to parameters of interest, to sustain valid conditional inference, forecasting and policy analysis respectively (Hendry, 1980). The various tests of exogeneity are important because weak exogeneity is needed for estimation purposes and for testing, strong exogeneity for forecasting and superexogeneity is required for policy analysis (Caporale, 1996). The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another (Granger, 1969).

The Weak exogeneity in a cointegrated system is a notion of long-run causality (Hall and Milne, 1994). However, the restrictions are meaningful if the adjustment coefficients or the loading factor which simply measures the speed of adjustment of variables is statistically significant and negatively signed (Wickens, 1996). Additionally a weak exogeneity is simply a variable in a cointegrated system that does not respond to discrepancy arising from long-run relationship. In other words, a variable is weakly exogenous if the coefficient of the speed of adjustment is zero i.e. $\alpha_i$=0, and this indicates that there is no feedback response from the system (Enders, 2004).

Thus a test of zero restriction (i.e. $\alpha$=0) is a test of weak exogeneity (Johansen and Joselius, 1992). Hall and Milne (1994) showed that the long-run causality is more efficient because it does not require two-steps procedure of estimating the cointegration relationship and the test of non- causality in VECM framework. Strong exogeneity requires weak exogeneity plus the absence of Granger causality (Cerqueira, 2009). The concept of super exogeneity combines weak and the invariance of conditional parameters to interventions changing marginal parameters (Hendry, 1980).

In this present study, the equation 1 is used to test short run causality from logarithm of GDP (LGDP) to the logarithm of construction sector (LCS) based on the null hypothesis Ho: the null hypothesis $\beta_{12}$=0, if this is rejected then it suggest that GDP causes construction sector (CS). To test the long run causality i.e. the weak exogenous test, we use the null hypothesis Ho: $\alpha_{11}$=0 by using likelihood ratio test with $\chi^2$ distribution. The overall causality in the system is tested through the strong exogeneity test. To perform the strong exogeneity test $LGDP_t$ does not cause $LCS_t$, we use the null hypothesis Ho: $\beta_{12}=0=\alpha_{11}=0$, if the hypothesis is rejected it means LGDP significantly causes LCS. The VECM procedure however involves modelling the series after stationarity and cointegration status of the series has been determined.

## TEST FOR STATIONARITY

Cointegration analysis necessitates that the variables under consideration be integrated of the same order. Hence it is necessary to undertake unit root tests before cointegration analysis (Ghirmay, 2004). The formal method to test the stationarity of a time series data is the unit root test. Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) and Philips-Perron (PP) tests (Phillips and Perron, 1988) are applied to test the time series data for unit root.

## TEST FOR COINTEGRATION

Yule (1926) suggested that regressions based on trending time series data can be spurious. The problem of spurious regression led to the concept of cointegration (Granger and Newbold, 1974). Two time series are said to be cointegrated, when both are non-stationary, but a linear combination of those time series is stationary (Engle and Granger, 1991). The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship between the variables. The cointegration analysis is performed with a VAR cointegration test, using the methodology developed by Johansen (1988 and 1991) and Johansen and Juselius (1992).

## FORECAST ERROR VARIANCE DECOMPOSITION (FEVD)

With VECM, it is possible to dictate a variable which is endogenous or exogenous to the system but the relative degree of its endogeneity or exogeneity can only be effectively determined through the FEVD. The FEVD in essence show the portion of the forecast error variance for each variable that is attributable to its own innovations and to innovations from the other variables in the system (Brooks, 2008). Therefore, if a variable is mainly explained by its own shocks and less by the other variables in the system, it can be said that such variable is exogenous (Masih et al., 2009). This forecast error is a result of the variation in the current and future values of shocks. In line with what is expected, most of the forecast error variance of a variable is usually explained by its "own" innovations. The FEVD depends on the recursive causal ordering used to identify the structural shocks. Different causal orderings will produce different FEVD values. The VAR technique is used to estimate the FEVD.

## IMPULSE RESPONSE FUNCTIONS (IRFS)

The IRFs play an important role in describing the impact that shock has on economic variable and their propagation mechanism. The IRFs are used to analyse the response of current and future value of economic variables to a one standard deviation increase in the current value of the VAR identified shocks. The IRFs describe the reaction of endogenous macroeconomic variables such as output, consumption, investment and employment at the time of the shock and over subsequent points in time (Lütkepohl, 2008). Shock is used to denote a change or an unexpected change in a variable or perhaps simply the value of the error term during a particular time period. A shock to the i-th variable not only directly affects the i-th variable but it is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR (Brooks, 2008). Existing methods for constructing IRFs and their confidence intervals depends on auxiliary assumption on the order of integration of the variables. The estimate of the IRFs and their confidence interval are commonly based on Griffith and Lutkepohl (1990) asymptotic normal approximations or bootstrap approximations to that distribution (Kilian, 1998).

## Empirical Estimation

Figure 1 shows the changing trends for each of the time series data for Nigeria. The line graph shows that the GDP had an upward growth between 1970 and 1977. From 1977 it begins an era of downward growth up to 1984; it then begins a moderate growth up to 2015. For the construction sector there was an upward growth between 1970 and 1982 and a downward growth between 1982 and 1999. The growth took an upward direction between 1999 and 2016. From the graph it is very clear that the GDP had more rapid growth than the construction sector during the period 1970 through 2016. For the construction sector the line indicates a slow growth throughout the period 1970 through 2016.

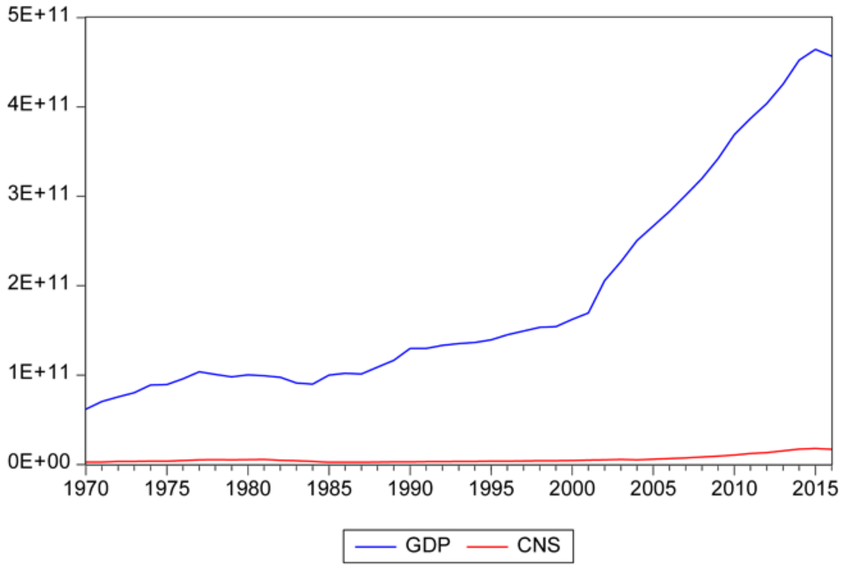


Figure 1 Line graph of Gross Domestic Product (GDP) and construction sector (CS)

Table 1 presents the descriptive statistics of the two time series data, CS and GDP. The statistics shows that the construction sector has a mean of $5.82\text{Ex}10^{09}$ and a standard deviation of $4.14\text{x}10^{09}$ the Jacque-Bera value of 30.72192 with a p value = 0.0000 suggest a normal distribution. Furthermore, the statistics shows that the GDP has a mean of $1.86\text{x}10^{11}$ and a standard deviation of $1.21\text{x}10^{11}$ the Jacque-Bera value of 9.630053 with a p value of 0.008107; suggesting a normal distribution.

Table 1 Descriptive statistics of CS and GDP

| | GDP | CS |
|---|---|---|
| Mean | 1.86E+11 | 5.82E+09 |
| Median | 1.35E+11 | 4.30E+09 |
| Maximum | 4.64E+11 | 1.78E+10 |
| Minimum | 6.17E+10 | 2.23E+09 |
| Std. Dev. | 1.21E+11 | 4.14E+09 |
| Skewness | 1.105754 | 1.732029 |
| Kurtosis | 2.836575 | 4.920441 |
| Jarque-Bera | 9.630053 | 30.72192 |
| Probability | 0.008107 | 0.000000 |
| Sum | 8.76E+12 | 2.74E+11 |
| Sum Sq. Dev. | 6.75E+23 | 7.90E+20 |
| Observations | 47 | 47 |

## RESULT OF STATIONARITY TEST

To obtain a formal statistical measurement of the time series data stationarity, the study conducted unit root tests using the Dickey Fuller (DF) test. Table 2 shows the result of the test of DF test at 1, 5 and 10 percent critical level. It indicates that the construction sector and the GDP are non-stationary at level. The study subsequently transformed the time series data to natural logarithm and the test for stationarity rerun using ADF and PP tests.

Table 2 Unit root test for CS and GDP at level with DF

| | DF test | | DF test | | DF test | | DF test | |
|---|---|---|---|---|---|---|---|---|
| Test critical values: | No trend | With trend | No trend | With trend | No trend | With trend | No trend | With trend |
| Unit root test for at level | CS | | LCS | | GDP | | LGDP | |
| 1% level | -2.617364 | -3.770000 | -2.617364 | -3.770000 | -2.617364 | -3.770000 | -2.617364 | -3.770000 |
| 5% level | -1.948313 | -3.190000 | -1.948313 | -3.190000 | -1.948313 | -3.190000 | -1.948313 | -3.190000 |
| 10% level | -1.612229 | -2.890000 | -1.612229 | -2.890000 | -1.612229 | -2.890000 | -1.612229 | -2.890000 |
| test statistic | -1.266940 | -1.919532 | -0.040232 | -1.495130 | -0.040232 | -1.495130 | 1.170240 | -1.582406 |

Table 3 presents the result of stationarity test at level and first difference of the time series data performed using the ADF and PP tests with trend and no trend. All the time series data indicated I (1). A deterministic trend in the data is therefore assumed. The ADF and PP test statistics (p values) for construction sector (LCS) and GDP (LGDP) are reported in the table. It can be observed that the ADF and the PP tests lead to almost the same conclusion regarding the integration properties of the series. All the series are therefore taken as difference stationary i.e. I (1). Since all data series are stationary at first difference i.e. I (1), test for co-integration is very critical.

Table 3 With ADF and PP at level and first difference

| | ADF at level | | ADF at 1ST difference | | PP test at level | | PP test at 1ST difference | | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| | no trend | with trend | no trend | with trend | no trend | with trend | no trend | with trend | |
| CS | 0.7484 | 0.7312 | 0.0859 | 0.1312 | 0.9997 | 0.9978 | 0.0705 | 0.2238 | I(1) |
| GDP | 0.9897 | 0.9005 | 0.0880 | 0.0975 | 1.0000 | 0.9943 | 0.1024 | 0.1178 | I(1) |
| LCS | 0.8693 | 0.8287 | 0.0075 | 0.0305 | 0.9554 | 0.9469 | 0.0075 | 0.0305 | I(1) |
| LGDP | 0.9860 | 0.8200 | 0.0005 | 0.0023 | 0.9700 | 0.8847 | 0.0006 | 0.0023 | I(1) |

## COINTEGRATION TEST ESTIMATES

Table 4 reports the results of cointegration tests, the null hypothesis is that there is no cointegrating vector and the alternative is that there is one cointegrating vector. The results reveal that both the trace tests and the maximum Eigen value test reject the null hypothesis of zero cointegrating vectors in favour of one cointegrating vector at the 5 per cent significance level (p-values = 0.0212). This signifies that there is true significant relationship between the construction sector and GDP in long run. The establishment of cointegration confirms the existence of a long-term equilibrium contemporaneous relationship between the time series data and that they have a common trend, and suggests that a causal relationship must exist in at least in one direction. However, although cointegration suggests the presence of Granger causality between the variables, it does not provide information on the direction of causality. Therefore the direction of causality is identified using the VECM derived from the long-run cointegrating vectors.

Table 4 Cointegration test

| Hypothesized No. of Cointegration Equation (CE) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Probability. | Max-Eigen Statistic | 0.05 Critical Value | Probability. |
|---|---|---|---|---|---|---|---|
| None | 0.212505 | 14.50487 | 12.32090 | 0.0212** | 10.75041 | 11.22480 | 0.0605* |
| At most 1 | 0.080047 | 3.754452 | 4.129906 | 0.0625 | 3.754452 | 4.129906 | 0.0625 |

*,**,*** denotes rejection of the hypothesis at .10, 0.05 and .01 level

Table 5 shows selection criteria for lag length based on the analysis of likelihood (LR), final prediction error (FPE), akaike information criterion (AIC), Schwartz information criterion (SIC) and hannan-quinn information criterion (HQ). It could be seen that all the criteria selected the lag length of two.

Table 5 VAR Lag Order Selection Criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -41.92173 | NA | 0.026440 | 2.042871 | 2.124787 | 2.073079 |
| 1 | 113.7957 | 289.7069 | 2.28e-05 | -5.013755 | -4.768006 | -4.923130 |
| 2 | 122.9860 | 16.24332* | 1.79e-05* | -5.255164* | -4.845583* | -5.104123* |
| 3 | 123.1385 | 0.255364 | 2.15e-05 | -5.076211 | -4.502797 | -4.864754 |
| 4 | 127.4666 | 6.844360 | 2.13e-05 | -5.091469 | -4.354223 | -4.819595 |

* indicates lag order selected by the criterion

## CAUSALITY AND EXOGENEITY TEST ESTIMATES

The short-run causality estimates are presented in Table 6. The results indicate significant short-run causality between LCS and LGDP. The LGDP significantly causes the LCS $\chi$ = 7.562936, p-value = 0.005958 similarly the LCS significantly causes the LGDP $\chi$ = 6.773933; p-value = 0.009250. Thus a bidirectional causal relationship exists between the LCS and LGDP (see table 6). The long run weak exogeneity estimate provides statistical evidence that both the LCS and LGDP are not exogenous in the system with $\chi$ = 4.659538, p-value = 0.030881 and $\chi$ = 2.935638, p- value = 0.086644 respectively. Thus a bidirectional long run causality between the LCS and the LGDP in the system (see table 6). The long run strong exogeneity tests estimates indicate that all conceivable null hypotheses in the system are rejected at 5 percent level of significance. This means that there is a significant long run relationships between the LCS and the LGDP (see Table 6).

Table 6 Causality and Exogeneity Tests

| Granger causality | Null hypothesis | Chi-sq | Prob. |
|---|---|---|---|
| Variables | | | |
| LGDP →LCS | $B_{11}=0$ | 7.562936 | 0.005958** |
| LCS →LGDP | $B_{22}=0$ | 6.773933 | 0.009250** |
| Weak Exogeneity Test | | | |
| LCS | $a_{21}=0$ | 4.659538 | 0.030881** |
| LGDP | $a_{11}=0$ | 2.935638 | 0.086644* |
| Strong exogeneity test | | | |
| LCS →LGDP | $B_{22}=a_{21}=0$ | 6.844218 | 0.032644** |
| LGDP →CS | $B_{11}=a_{11}=0$ | 7.565711 | 0.022758** |

*, **, *** show the rejection of null hypothesis at 10%, 5% and 1% respectively.

## FEVD ESTIMATES

Table 7 presents the FEVD estimates. The forecast horizon is 10 years and the contribution of each variable shocks and to the shocks of other variables in the system are explained. For the LCS, the result indicates that between 72 and 99.5 percent of its FEVD is explained by its own shocks. The result also indicates that LCS explains between 0.00 and 9.32 percent of the error variance in the LGDP through the 10 year time horizon, which suggest that the impact of LCS on the LGDP is not significant. For the LGDP, the result indicates that the LGDP explains between 90.68 and 100 percent of its own variance with the strength of the explanation decreasing along the horizon. The LGDP explains a relatively less significant proportion of error variance of between 0.48 and 30.89 percent in the LCS with the strength of explanation increasing along the horizon, suggesting that the LGDP has lesser significant impact on the LCS in long run. In summary, the result confirms the LGDP as the most exogenous in the system contributing more to the error variance of LCS than LCS contributes to the error variance in LGDP.

Table 7 FEVD Estimates

| Variance Decomposition of LGDP: | | | |
|---|---|---|---|
| Period | Standard Error (S.E) | LGDP | LCS |
| 1 | 0.044012 | 100.0000 | 0.000000 |
| 2 | 0.071006 | 99.31922 | 0.680780 |
| 3 | 0.092702 | 99.25702 | 0.742980 |
| 4 | 0.111902 | 99.48949 | 0.510506 |
| 5 | 0.129724 | 99.34297 | 0.657025 |
| 6 | 0.146723 | 98.52600 | 1.474005 |
| 7 | 0.163216 | 97.06092 | 2.939082 |
| 8 | 0.179350 | 95.12676 | 4.873237 |
| 9 | 0.195157 | 92.93843 | 7.061568 |
| 10 | 0.210610 | 90.67999 | 9.320013 |
| Variance Decomposition of LCS: | | | |
| Period | Standard Error (S.E) | LGDP | LCS |
| 1 | 0.086667 | 0.482746 | 99.51725 |
| 2 | 0.147656 | 1.042298 | 98.95770 |
| 3 | 0.194890 | 3.447846 | 96.55215 |
| 4 | 0.229315 | 6.550398 | 93.44960 |
| 5 | 0.253342 | 10.14643 | 89.85357 |
| 6 | 0.269961 | 14.16011 | 85.83989 |
| 7 | 0.281929 | 18.45025 | 81.54975 |
| 8 | 0.291405 | 22.81131 | 77.18869 |
| 9 | 0.299877 | 27.01988 | 72.98012 |
| 10 | 0.308236 | 30.88807 | 69.11193 |
| Cholesky Ordering: LGDP LCS | | | |

### RESULTS OF THE IRFS

Figure 2 shows that at the responses of LCS and LGDP are largely due their own shocks. The response of LGDP to LGDP is positive and increases in strength along the horizon up to period 10. The response of LGDP to the LCS is positive but weak up to period 3. Thereafter it becomes negative up to period 10. The response of LCS to LCS is positive at the beginning and grows in strength up to period 3 and thereafter reduces in strength and becomes negative at period 9. In summary, the result of the IRFs consistent with the earlier VECM, Granger Causality and FEVD results that the LGDP changes lead the LCS.

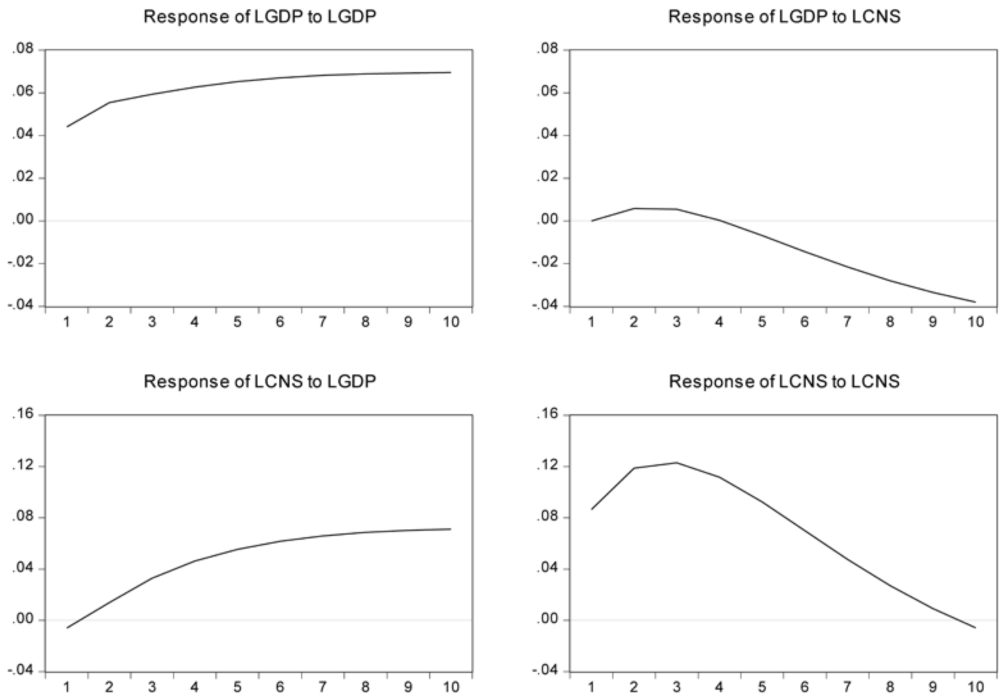


Figure 2 Response to Cholesky One S.D. Innovations

## Discussion of Results

For the GDP → CNS causality, the short run granger causality indicated that the GDP significantly granger caused the construction sector (CS), the long run weak and strong exogeneity tests indicate significant long run significant effect of the GDP on the construction sector (CS). In summary, all the tests agree that the GDP significantly caused the construction sector (CS).

The primary drivers of construction investment demand are the economy and government policy on the economy. The demand for the construction investment is derived from the demand for consumer goods. A period of real GDP growth tends to raise consumer demand for goods and services which in turn triggers up the demand for construction investment. Thus the construction investment demand often reflect business cyclical fluctuations, general business confidence, state of the economy including shocks and government (fiscal & monetary) policies, real interest rate and aggregate demands. Other factors include manufacturing capacity, remodelling (renovation), unemployment, population, profits and technology. The combined detrimental effect of these factors on construction investment is the unstable/volatile nature of construction demand (Yiu et al., 2004). The effect of the GDP on construction sector (CS) can also be explained by the investment function. It is any variable that can motivate investors to change their typical buying and selling behaviours to either take advantage of the economic shift in a bid to increase their returns, or to minimize their loss incurred as a result of that shift. Rational investor will normally consider the current level of economic activities (i.e. GDP) and the real interest rates. The construction investment function indicates that real interest rate is negatively related to construction investment given that the interest rate is a measure of the opportunity cost of capital while the GDP and Tobin's q are positively related to investment (Burda, 2005).

For the CS → GDP causalities, the short run granger causality test indicated that the construction sector (CS) significantly granger caused the GDP, while the long run weak and strong exogeneity tests indicate significant long run effect of the CS on the GDP. This agrees with all economic growth models, especially the Harod-Domar model, neo-classical growth and endogenous growth models. These models suggest that investment in fixed capital including construction as one of the critical factors for growth in output. The construction sector contributes at least 50 percent of the Domestic Fixed Capital formation. Thus the Harrod-Domar Model, Neoclassical growth theory and the endogenous theories all explained the importance of Fixed Capital investment including construction for output growth. Additionally the construction sector contributes up to 10 percent to the GDP (Begg et al., 2000; Hillebrandt, 1988, 2000).

## Conclusions

The paper concluded that the Nigerian construction sector output makes significant impact on the gross domestic product (GDP) both in the short run and long run in line with classical, neoclassical and endogenous growth theorems. The Nigerian construction sector contributes up to 50 percent to the domestic fixed capital formation, about 10 percent of the Gross Domestic Product (GDP) and about 20 percent of employment. Similarly, the paper concluded that the gross domestic product (GDP) makes significant impact on the Nigerian construction sector both in the short run and long run as explained by the construction investment demand function. The demand for the construction sector (CS) investment is derived from the demand for consumer goods. A period of real GDP growth tends to raise consumer demand for goods and services which in turn triggers up the demand for construction investment. The government is the single largest client and responsible for 60 percent of the Nigerian construction sector output, thus the government is directly responsible for the lion share of the sector's activities. Government massive construction programme is needed for sustainable growth and development of Nigerian constructed infrastructure and the revitalization of the Nigerian construction sector given that the lull in the sector are attributable to the poor implementation of government budget.

This study is therefore of significance, to enhance economic growth and construction sector investment in Nigeria. Going by this study, both the Nigerian economy and construction sector have effects one another. Therefore, economic and construction sector developmental plans should be done concurrently in the country. Currently in Nigeria, the economy is planned to contribute to different sectors. This is confirmed in this study. The Nigeria's GDP contributes positively to the construction sector. Furthermore, this study revealed that the construction sector contributes to the GDP in short and long runs. However, there is hardly a plan for sector contribution to the economy in Nigeria. This should discontinue. Henceforth, there should be a sector by sector plan towards economic development in Nigeria. Particularly in the construction sector, the government should have an infrastructure development plan that includes spending and revenue targets. The Nigeria's government Economic Recovery and Growth Plan (ERGP) (2017-2020) lays out government's plan to restore growth after the economic recession in 2016. In the ERGP, the Nigeria's GDP is projected to grow by 2.3% in 2019 and 2.4% in 2020. This study is of significance to the ERGP. The action points in the ERGP should be implemented especially those pertaining to infrastructure spending. In addition, before the year 2020, a short term construction sector plan should be made. This should be specifically designed to contribute to the economic projections in the ERGP.

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